May 3, 1888.

Professor G. G. STOKES, D.C.L., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

In pursuance of the Statutes the names of the Candidates recommended for election into the Society were read from the Chair as follows:—

Andrews, Thomas, F.R.S.E.
Bottomley, James Thomson, M.A.
Boys, Charles Vernon.
Church, Arthur Herbert, M.A.
Greenhill, Professor Alfred George, M.A.
Jervois, Sir William Francis Drummond, Lieut.-Gen. R.E.
Lapworth, Professor Charles, LL.D.
Parker, Professor T. Jeffery.
Poynting, Professor John Henry, M.A.
Ramsay, Professor William, Ph.D.
Teale, Thomas Pridgin, F.R.C.S.
Topley, William, F.G.S.
Trimen, Henry, M.B.
Ward, Professor Henry Marshall, M.A.
White, William Henry, M.I.C.E.

The Right Hon. John Hay Athol Macdonald, whose certificate had been suspended as required by the Statutes, was balloted for and elected a Fellow of the Society.

The following Papers were read:—

I. "On the Induction of Electric Currents in conducting Shells of small Thickness." By S. H. BURBURY, M.A., formerly Fellow of St. John's College, Cambridge. Communicated by H. W. WATSON, D.Sc., F.R.S. Received March 22, 1888.

(Abstract.)

1—4. Definition of current sheets, current shells, superficial currents, and current function.

5. Expression for the vector potential of the currents in a sheet.

6. Expression for the energy of a system of current sheets in terms of the current function and magnetic potential, viz.:—

$$2T = \iint \phi \frac{d\Omega}{d\nu} dS,$$

where ϕ is the current function, Ω the magnetic potential, and $d\Omega/d\nu$ the rate of its variation per unit of length of the normal.

7. The magnetic induction due to the sheet with current function ϕ is the same as that due to a magnetic shell of strength ϕ over the surface at all points not within the substance of the shell.

8. Given any magnetic field external to a surface, S, there exists a determinate system of magnetic shells over S having at all points within the surface magnetic potential equal to that of the external field.

9 and 10. Therefore also a system of currents over the surface having the corresponding property, called the *magnetic screen.* Example of a sphere.

11, 12, and 13. If the function ψ satisfy the conditions

$$d\psi/d\nu = lF + mG + nH \quad \text{on S},$$

$$\nabla^2\psi = 0 \quad \text{within S},$$

then $F = d\psi/dx$, &c., if F, G, H be the components of vector potential due to the external system and its *magnetic screen.* ψ is called the companion function to F, G, H.

14—17. Solution of the problem of induction in the absence of resistance by Lagrange's equations, where the external system varies continuously, in the form—

$$\frac{d}{dt}\frac{dT}{d\phi} = 0,$$

where

$$2T = \iint \phi_0 \left(\frac{d\Omega_0}{d\nu} + \frac{d\Omega}{d\nu}\right) dS_0$$

$$+ \iint \phi \left(\frac{d\Omega_0}{d\nu} + \frac{d\Omega}{d\nu}\right) dS,$$

where ϕ_0, Ω_0, and S_0 relate to the external system, and ϕ, Ω, and S to the induced currents on S.

18. This gives at all points within S

$$\frac{d(F_0 + F)}{dt} = \frac{d(\psi_0 + \psi)}{dx}, \text{ \&c.,}$$

where ψ_0 is the companion function to $\frac{dF_0}{dt}$, $\frac{dG_0}{dt}$, and $\frac{dH_0}{dt}$, and ψ to $\frac{dF}{dt}$, $\frac{dG}{dt}$ and $\frac{dH}{dt}$.

19. If therefore $-dF/dt$, &c., are to be regarded as components of an electromotive force, notwithstanding their derivation from a potential within S, they will produce on S a distribution of free electricity having potential $-(\psi_0 + \psi)$, and forming a complete *electric screen.*

20. There is no energy of mutual action between the electrostatic system, if it exists, and the electric currents, because

$$\iint \left(u\frac{d\psi}{dx} + v\frac{d\psi}{dy} + w\frac{d\psi}{dz}\right) dS = 0.$$

21 and 22. The effect of resistance generally.

23. Definition of self-inductive current shells, viz., those for which the values at any time, t, of the component currents, u, v, w, &c., are found from their values at a given epoch by multiplying by $\epsilon^{-\lambda t}$ where λ is constant.

24. Investigation of the condition which ϕ, the current function, must satisfy in order that a current shell may be capable of being made self-inductive.

25. If this condition be satisfied, the thickness of the shell which makes it self-inductive is determinate, the material being supposed uniform.

26. And λ varies inversely as the thickness.

27. General property of self-inductive shells in presence of a corresponding magnetic field whose potential is Ω_0 expressed by the equation—

$$\frac{d\Omega_0}{dt} + \frac{d\Omega}{dt} + \lambda\Omega = 0,$$

at all points within the shell, or on the opposite side of it to the inducing system.

28. Example (1), when $d\Omega/dt =$ constant.

29. Example (2), when $\Omega_0 = A \cos \lambda t$ and λ constant.

30. Some consequences deduced from the last example.

Examples of self-inductive shells, viz.:—

31. Spherical shell.

32. Solid of revolution about the axis of z, ϕ being a function of z only.

33. Any surface if ϕ be a function of z only and ψ a function of x and y only.

34. Example, an ellipsoidal shell.

35. Case of an infinite plane sheet as made self-inductive in certain cases.

36. Case of an infinite plane sheet when not self-inductive. Arago's disk.

37—40. Self-inductive shells bounded by a surface, S, when S is a homogeneous function of x, y, and z.

A solid formed of such shells and the action of outer shells upon inner ones, or *vice versâ*.

40. Case of a solid shell of small finite thickness.

41. Of statical distribution of electricity on a conductor as produced by variation of magnetic field.

42. Of non-self-inductive systems.

II. "On the Relations of the Diurnal Barometric Maxima to certain critical Conditions of Temperature, Cloud, and Rainfall." By HENRY F. BLANFORD, F.R.S. Received March 30, 1888.

(Abstract.)

The author refers to an observation of Lamont's that the diurnal barometric variation appears to be compounded of two distinct elements, viz., a wave of diurnal period, which is very variable in different places, and which appears to depend on the horizontal and vertical movements of the atmosphere and changes in the distribution of its mass, and a semi-diurnal element which is remarkably constant and seems to depend more immediately on the action of the sun. Then, referring to the theory of the semi-diurnal variation, originally put forward by Espy, and subsequently by Davies and Kreil, the author points out that the morning maximum of pressure approximately coincides with the instant when the temperature is rising most rapidly. This is almost exactly true at Prague, Yarkand, both in winter and summer, and in the winter months at Melbourne. At the tropical stations, Bombay, Calcutta, and Batavia, and at Melbourne in the summer, the barometric maximum follows the instant of most rapid heating by a shorter or longer interval; and the author remarks that this may probably be attributed to the action of convection, which must accelerate the time of most rapid heating near the ground surface; while the barometric effect, if real, must be determined by the condition of the atmosphere up to a great height. With reference to Lamont's demonstration of the failure of Espy's theory, a condition is pointed out which alters the data of the problem, viz., the resistance that must be offered to the passage of the pressure-wave through the extremely cold and highly attenuated atmospheric strata, whose existence is proved by the phenomena of luminous meteors.

With respect to the evening maximum of pressure, it is pointed out that very generally, and especially in India, and also at Melbourne, there is a strongly-marked minimum in the diurnal variation of cloud between sunset and midnight, which, on an average, as at Allahabad